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ABSTRACT

Nineteen secondary school teachers in a mid-sized Florida school district participated in a single-group pretest/posttest design to explore the relationship between essential and higher order teaching skills. Correlations between two sets of teacher performance variables were computed before and after training in teaching for higher order thinking (THOT). Three 4-hour training sessions and seven 2-hour workshops were held over an 11-week period. The purposes of the first three sessions were to introduce, define, and provide acceptable and unacceptable examples of THOT skills. The seven workshop sessions focused on developing and critiquing thinking-skill lesson plans. The teachers were observed on two occasions by two observers using an instrument based on the Florida Performance Measurement System (FPMS), and on two occasions by two observers using an instrument developed to measure THOT. Teachers' participation in the training program resulted in a substantial increase in THOT scores but no increases in the FPMS scores. Correlations between the two scores were not significant on either occasion. Implications of the results are discussed and it is suggested that training in the teaching of higher order thinking is necessary for many teachers. Five tables contain study data, and three figures illustrate the domains and the indicator coding pattern. (SLD)

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Toward Establishing Relationships Between Essential and Higher Order Teaching Skills

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Paper Presented at the Annual Meeting of the Eastern Educational Research Association, Boston, February 13-16, 1991.

Toward Establishing Relationships Between Essential and Higher Order Teaching Skills

Abstract

Nineteen teachers participated in a single-group pretest-posttest design to explore the relationship between essential and higher order teaching skills. The teachers were observed on both occasions using an instrument designed to measure essential teaching skills (FPMS) and an instrument designed to measure teaching of higher order thinking skills (THOT). Teachers' participation in a training program in the teaching of higher order thinking resulted in substantial increases in the THOT scores, but no increases in the FPMS scores. Additionally, non-significant correlations were obtained between the two scores on both occasions. The results were interpreted in terms of implications for teacher education and teacher evaluation.

Empirical research on teaching has shown that specific teacher performance variables such as use of time, handling of materials, questioning, and maintaining discipline, are related to improvement in student achievement and conduct. In addition, students' acquisition of higher-order thinking skills has been related to specific teacher performance that leads students to (a) identify subject-related problems and variables, (b) hypothesize and test hypotheses, and (c) validate generalizations.

Improvements in student achievement and conduct, and student acquisition of higher-order thinking skills are high priorities of education. This claim is supported by the emphasis given to basic academic instruction in the early 1980's, an emphasis resulting in large part from the finding in A Nation at Risk (1983) that standardized achievement test scores were dropping. Further support is given by the recent emphasis on developing skills in reasoning, thinking critically, and problem-solving suggested by Educating Americans for the 21st Century (1984).

In their pursuit of improvements in student achievement, conduct, and higher-order thinking, educators may seek improvements in facilities, equipment, curriculum, or teacher performance. Although all of these factors may affect the desired improvements, the performance of teachers is probably the most important. Empirical research (Evertson, 1980; McDonald, 1976; Soar, 1968; Stallings, 1981) supports the primacy of teacher performance as a predictor of student learning. The empirical research on teacher effectiveness provides a solid basis on which to define effective teaching, examine current practice, attempt to improve practice, and evaluate the results of such attempted improvements.

The purposes of this study were (a) to examine the relationship between teacher performance that is related to student achievement and conduct, and teacher performance that is related to student acquisition of higher order thinking skills; and (b) to examine the effects of a training program in teaching

higher order thinking skills on both sets of teacher performance variables. Previous research (Peterson, Kromrey, Borg, & Lewis, 1990) suggested that (a) these two classes of teacher performance variables are relatively independent; (b) incidences of the behaviors related to the teaching of higher order thinking skills are relatively rare occurrences; and (c) the frequency of occurrence of teacher behaviors related to higher order thinking skills can be substantially increased through specific training. These conclusions were tentatively advanced by Peterson et al (1990), based upon a small sample of participating teachers. An additional purpose of this research, therefore, was to verify the findings of the Peterson et al (1990) study, using a larger sample of teachers.

Knowledge Base

Teacher performance that relates to student achievement and conduct, we have called essential teaching skills. These skills are considered essential because without discipline in the classroom, organization of instruction, and effective interaction with students, the literature indicates that student acquisition of knowledge is impaired.

The domains, or areas, of essential teaching skills, delineated in Figure 1, were derived from process/product studies in which student achievement and conduct were the dependent variables. The results of the search of over 300 studies were organized into six domains, which include 34 concepts and 124 indicators of teacher classroom performance (Domains: Knowledge Base of the Florida Performance Measurement System (FPMS), 1983). Examples of specific observable teacher behaviors (indicators) for each domain are presented in Figure 1.

Through a similar process, the domains, concepts, and indicators for teaching higher order thinking were derived from some 500 quantitative studies in which the dependent variables were student acquisition of procedures for reasoning, solving

problems, or critical thinking. Where the essential teaching skills help students to acquire knowledge of a subject and to recall and reproduce this knowledge, teaching for higher order thinking helps students to manipulate information stored in memory -- to interrelate or rearrange the information to achieve a purpose, to solve a problem, to resolve an argument, or to make a prediction. The results of this literature search were organized into five domains, that include 15 concepts and 64 indicators. The five domains of Teaching for Higher Order Thinking (THOT) are Developing and Maintaining Flexibility and Student Awareness; Generating and Validating Generalizations; Assessing Arguments; Negotiating Issues and Solving Interpersonal Problems; and Making Judgments Under Uncertainty. Measures of only the first two of these domains were used in this study. Examples of indicators for these two domains are presented in Figure 2.

The two sets of domains, derived from two distinct bodies of literature, reflect teacher behaviors used for two distinct purposes (related to student achievement/conduct and student reasoning/problem-solving). Both sets of skills reflect important elements of teaching.

Method

This study was a single-group pretest-posttest design. Correlations between the two sets of teacher performance variables were computed before and after the training in teaching higher-order thinking, and the effectiveness of the training program was investigated by testing for differences in mean performance scores before and after the training.

Subjects

Nineteen secondary school teachers in a mid-sized Florida school district participated in the study. The participating teachers represented a variety of content fields, including

science, mathematics, home economics, language arts, and social studies. All participants were volunteers for the project.

Instrumentation

Concurrent with the development of the knowledge base for the essential teaching skills, researchers developed a classroom observation instrument for the measurement of the concepts and indicators of those domains. This instrument, the FPMS Summative Observation Instrument, is used by trained and certified observers to code teacher performance. The summative instrument has been tested in reliability studies, resulting in reliability coefficients ranging from 0.91 to 0.98 (Teacher Evaluation Study, 1983-1984); has been normed on a representative sample of Florida teachers; and has gained substantial empirical evidence for predictive validity in five subject-specific studies (Teacher Evaluation Study, 1985-1986).

The instrument used to measure higher order teaching performance is a combination of concepts and indicators from the THOT domains of (a) Developing and Maintaining Flexibility and Student Awareness, and (b) Generating and Validating Generalizations. As with the FPMS summative instrument, data are collected on this instrument by coding indicators of teacher performance. The estimated intercoder agreement on the THOT instrument is 0.82.

Training Program

Training in the teaching of higher-order thinking took place in the fall of 1989. Nineteen teachers in the areas of science, mathematics, home economics, language arts, and social studies participated.

Over a period of 11 weeks, three 4-hour training sessions and seven 2-hour workshop sessions were conducted. The purpose of the first three sessions was to introduce, define, and provide both

examples and nonexamples of THOT classroom performance skills. The training sessions were conducted in a lecture/interaction format. During the training, the participating teachers were asked to select a topic that was already in the regular curriculum, on which a higher order thinking lesson would be developed.

The seven workshop sessions were then spent developing and critiquing thinking-skill lesson plans. Lessons were developed by the teachers and critiqued by the research team and peer teachers in each subject area. Several potential topics in each subject area were presented during those sessions. Examples of topics chosen were (a) conditions that make ladybugs more active (science); (b) reasons time is an important resource (home economics); (c) determining how to measure quadrilaterals (mathematics); and (d) finding out what would happen if marijuana was legalized (social studies).

The sixth training session was devoted to editing each lesson and simulating presentations prior to practice teaching each lesson to a group of students. Practice-teaching sessions were videotaped and the videotapes were critiqued by the entire group during the eighth and ninth sessions.

The final editing of each lesson was conducted by subject-area subgroups during the tenth session, after which each teacher taught his/her lesson to a group of students. Each lesson was videotaped, and the videotape was later observed by trained observers using the FPMS Summative Instrument and the THOT instrument. These observations produced the posttest classroom performance data.

Results

Pretest Observations

For the pretest observations, each teacher was observed on two occasions by two different observers using the FPMS Summative Instrument and on two occasions by two observers using the THOT

instrument.

The FPMS observations were scored by (a) scaling the coding frequencies for each item according to criteria established in the instrument's norming, and (b) summing the item scale scores for each of the instrument's scales. The descriptive statistics for the FPMS observations are provided in Table 1. Comparing the obtained FPMS scores to Florida's norming distribution on the FPMS, the FPMS Total Performance scores provided a range of 64 percentiles; the Effective performance scores provided a range of 63 percentiles; and the Ineffective scores provided a range of 99 percentiles. Although the mean scores for the sample of teachers participating in this study was somewhat lower than mean for the norming population, an adequate degree of score variability was obtained.

The THOT observations were scored by (a) computing the square root of the number of times each item was coded as the item scale score, and (b) summing the item scale scores for each of the instrument scales. The descriptive statistics for this instrument are presented in Table 2. The indicators for Problem Formulation, Flexibility, and Student Awareness were coded more frequently than the indicators for the Development of Explanations and Validation of Generalizations.

The zero-order correlations between scores on the two instruments are presented in Table 3. The correlation between the Total THOT scores and the Total FPMS scores was essentially zero ($r = -0.01$). The FPMS Effective Scores showed a small negative correlation with the THOT scores ($r = -0.22$), and the FPMS Ineffective scores showed a moderate positive correlation ($r = 0.39$), although neither correlation was statistically significantly different from zero with this sample.

Posttest Observations

In parallel with the data collection strategy used for the pretraining observations, each teacher was observed on two

occasions by two different observers with each observation instrument following the training.

The descriptive statistics for the FPMS observations are provided in Table 1. The stability of the measures of essential teacher performance are evident in these data. The mean FPMS Total Performance score was 71.85, compared with 70.24 on the pretest, a difference which is not statistically significantly different from zero ($\underline{t}$ = 0.90, df= 18). Similarly, the mean Effective Performance score was approximately 2.4 points higher on the posttest, a difference which is not statistically significant ($\underline{t}$ = 1.43, df = 18); and the mean Ineffective Performance Score was approximately one point lower on the posttest, a difference which is also not significantly different from zero ($\underline{t}$ = -1.16, df=18).

The descriptive statistics for the THOT posttest observations are provided in Table 2. In contrast to the FPMS Observations, mean performance on all measured concepts was significantly higher ($\underline{p}$<.05) at posttest than at pretest. For the Total THOT score, the mean performance at posttest was approximately 0.4 points higher than mean performance at pretest ($\underline{t}$ = 5.68, df = 18, $\underline{p}$ < .05).

As an aide to interpreting the magnitude of the changes in measured teacher performance from pretest to posttest, the raw change scores (posttest score minus pretest score) and the effect sizes (raw change score divided by the standard deviation of the pretest scores) are presented in Table 4. The mean Total performance score on the THOT instrument at posttest was 2.47 standard deviations higher than the mean pretest THOT score. All of the subscale scores showed substantial increases, ranging in effect sizes from 1.11, for the measure of Student Awareness, to 3.15, for the measure of Development of Explanations.

A final presentation of pretest-posttest differences is provided in Figure 3. In this figure, the percentage of observations in which each indicator of the THOT instrument was coded is presented. Increases in the proportion of participating teachers' use of THOT behaviors is evidenced for all indicators, except Encourages Verbalization. This indicator showed a decrease

from 47% of the pretest observations, to 28% of the posttest observations.

The zero-order correlations between scores on the two instruments, based on the posttest observations are presented in Table 5. The correlation between the Total THOT scores and the Total FPMS scores was zero. The FPMS Effective Scores showed a small positive correlation with the THOT scores ($r = 0.08$), and the FPMS Ineffective scores showed a small negative correlation ($r = -0.15$). As with the pretest correlations, none of these coefficients differs significantly from zero.

Discussion

The sporadic evidence of THOT indicators in the pretest observations mirrors the results of Peterson et al (1990), that these behaviors do not occur often in classrooms. The substantial increase in the occurrence of these behaviors following the training program, an effect noted in the previous research, is similarly noted in these data. This outcome supports the effectiveness of the training program in providing the participating teachers with the behaviors associated with student acquisition of higher-order thinking skills. Of course, whether or not the participating teachers will continue to use these THOT behaviors in their classroom teaching awaits further research.

An implication of the results of this study, is that the low frequencies of THOT behaviors on the pretest suggest that training in the teaching of higher-order thinking is necessary for many teachers. Fortunately, the increase in THOT behaviors exhibited at the posttest suggests that such training in the teaching of higher-order thinking will be effective. The participating teachers in this study were willing and able to both learn and demonstrate teaching skills associated with higher-order thinking. The identification of the need to teach children how to think (e.g., Educating Americans for the 21st Century, 1984) must be matched with efforts to educate teachers in the specific

operations of teaching thinking. Identifying a need without identifying mechanisms (both preservice and inservice) to meet the need is unlikely to effect any improvement in education.

Finally, the stability of the measures of essential teaching skills in the pretest-posttest comparison supports the hypothesis that these two sets of teaching skills are relatively independent. The fact that the FPMS observation instrument did not register the improvement in the performance of the participating teachers indicates that the measurement of teacher performance in THOT behaviors requires different instrumentation than the current instruments for the measurement of essential teacher performance.

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Table 1

Distribution of Essential Teacher Performance Scores as Measured by the FPMS Summative Instrument.

	Pretest		Posttest	
FPMS Scale	M	SD	M	SD
Domain 3 Lesson Organization	22.71	2.31	25.39	3.03
Domain 3 Lesson Development	15.58	1.06	15.72	1.56
Domain 4 Subject Presentation	13.13	0.78	13.84	1.31
Domain 5 Communication	10.74	1.51	10.18	1.68
Domain 2 Management of Conduct	6.58	0.65	6.40	1.22
Effective Performance	34.49	3.98	36.88	4.70
Ineffective Performance	35.75	2.09	34.97	2.52
Total Performance	70.24	3.87	71.85	5.96

Note: N = 19. Scores are based on the average of two observations for each teacher.

Table 2

Distribution of Higher Order Thinking Teacher Performance Scores as Measured by the THOT Instrument.

	Pretest		Posttest	
THOT Scale	M	SD	M	SD
Problem Formulation	0.31	0.25	0.89	0.40
Development of Explanations	0.10	0.13	0.51	0.36
Validation of Generalizations	0.03	0.05	0.15	0.17
Flexibility	0.26	0.20	0.67	0.32
Student Awareness	0.31	0.27	0.61	0.32
Total THOT	0.18	0.15	0.55	0.22

Note: N = 19. Scores are based on the average of two observations for each teacher.

Table 3

Correlations Between Major FPMS Scores and THOT Scores at Pretest.

	FPMS Scores		
	Effective	Ineffective	Total
FPMS Ineffective	-0.31		
FPMS Total	0.86*	0.22	
THOT Total	-0.22	0.39	-0.01

* $p < .05$

Note: N = 19.

Table 4

Pretest and Posttest Raw Differences and Effect Sizes for FPMS and THOT Scores.

FPMS Score	Raw Difference	Effect Size	THOT Score	Raw Difference	Effect Size
Organization	2.68	1.16	Problem Formulation	0.58	2.32
Development	0.14	0.13	Dev. of Explanations	0.41	3.15
Sbjct Presentation	0.71	0.91	Validation of Generalizations	0.12	2.40
Communication	-0.55	-0.36	Flexibility	0.40	2.00
Mngmnt of Conduct	-0.18	-0.28	Student Awareness	0.30	1.11
Effective	2.39	0.60	Total THOT	0.37	2.47
Ineffective	-0.78	-0.37			
Total	1.61	0.42			

Note: N = 19.

Table 5

Correlations Between Major FPMS Scores and THOT Scores at Posttest.

	FPMS Scores		
	Effective	Ineffective	Total
FPMS Ineffective	0.29		
FPMS Total	0.91*	0.66*	
THOT Total	0.08	-0.15	0.00

* $p < .05$

Note: N = 19.

Figure 1

Domains and Indicators of Essential Teacher Performance

Domain	Sample Indicators
Planning	Analysis of content, use of instructional materials, specification of activity format, matching learner needs with instructional element
Lesson Organization	Begins instruction promptly, orients students to classwork, conducts review
Lesson Development	Asks questions requiring analysis, amplifies responses, provides for practice
Presentation of Subject Matter	Treats concepts, applies principles, applies academic rules, develops criteria and evidence for value judgments
Communication: Verbal and Nonverbal	Emphasizes important points, expresses enthusiasm, challenges students
Management of Student Conduct	Stops misconduct, maintains instructional momentum

Figure 2

Domains and Indicators of Teaching Higher Order Thinking

Domain	Sample Indicators
Developing and Maintaining Flexibility and Student Awareness	Warns against premature evaluation, provides incubation time, encourages verbalization
Generating and Validating Generalizations	Identifies and classifies variables, formulates generalizations, tests hypotheses, validates generalizations

Figure 3
THOT Indicator Coding Pattern on Pre and Post Observations

THOT Indicator	Pct of Obs. With Coding	Histogram
Problem Formulation		
Presents Background	55 93	
Cites Variables	26 67	
Poses Problem	47 93	
Uses Analogies	13 26	
Development of Empirical Explanations		
States Generalization	26 79	
Classifies	10 22	
Determine Testability	16 28	
Uses hypothesis	05 10	
Falsifies hypothesis	03 09	
Models variable control	03 10	
Plans experiment	16 69	

THOT Indicator	Pct of Obs. With Coding	Histogram
Validation of Generalizations		
Guard against overgeneralization	03 26	
Analyze explanatory power	08 14	
Relate conclusion to knowl.	05 21	
Evaluate alternative conclusion	00 14	
Flexibility		
Warn against premature eval	08 65	
Provide exploratory materials	24 31	
Allow thinking time	53 86	
Student Awareness		
Thinks aloud	40 50	
Makes content explicit	29 60	
Encourages verbalization	47 28	
Uses small groups	10 88	

Key: Pretest Observations
Posttest Observations

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